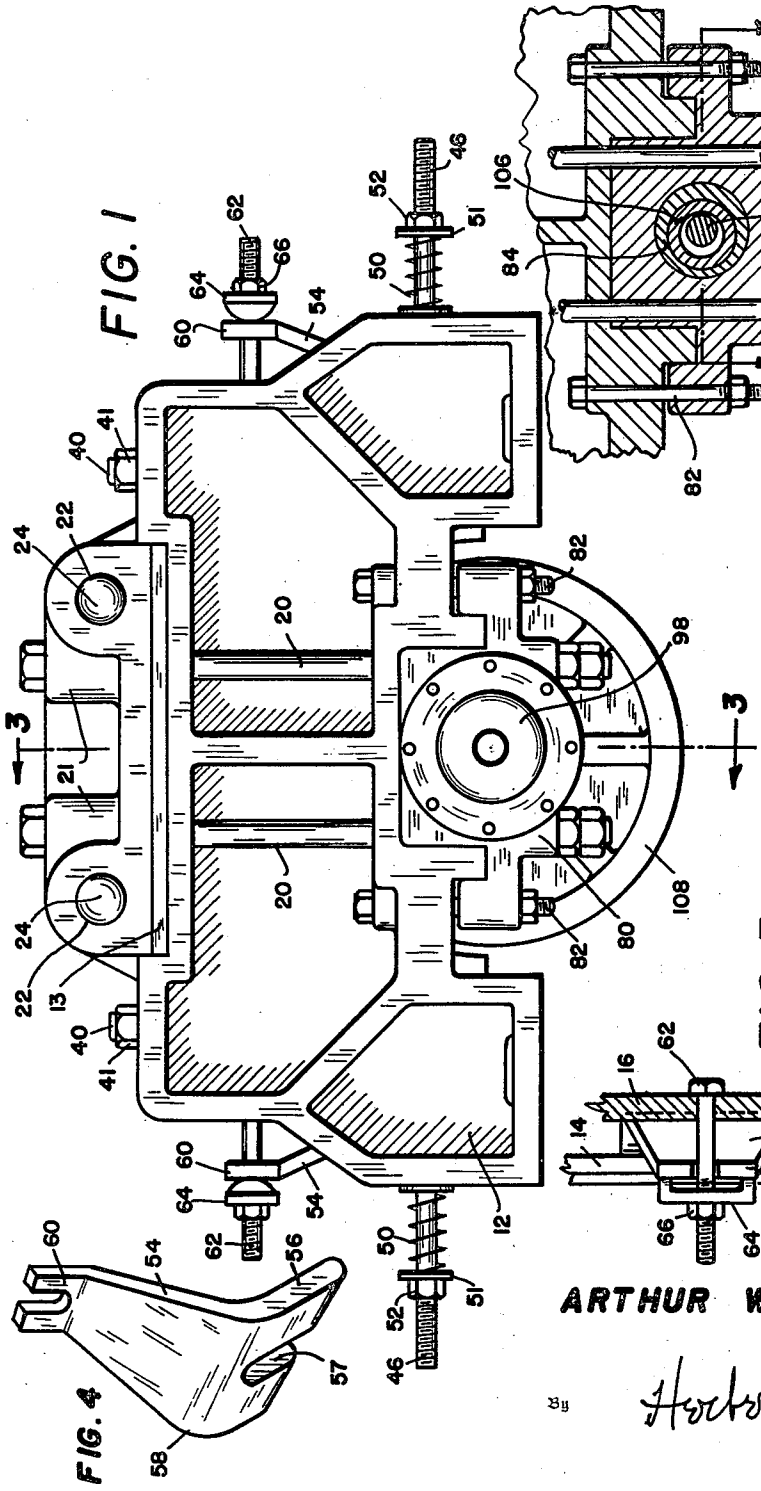
Dec. 1, 1942. A. W. FAHRENWALD 2,303,923

CRUSHER

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CRUSHER

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FIG. 10

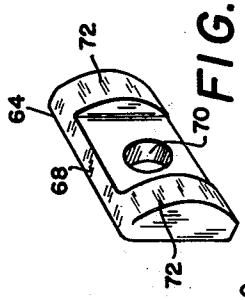


FIG. 2

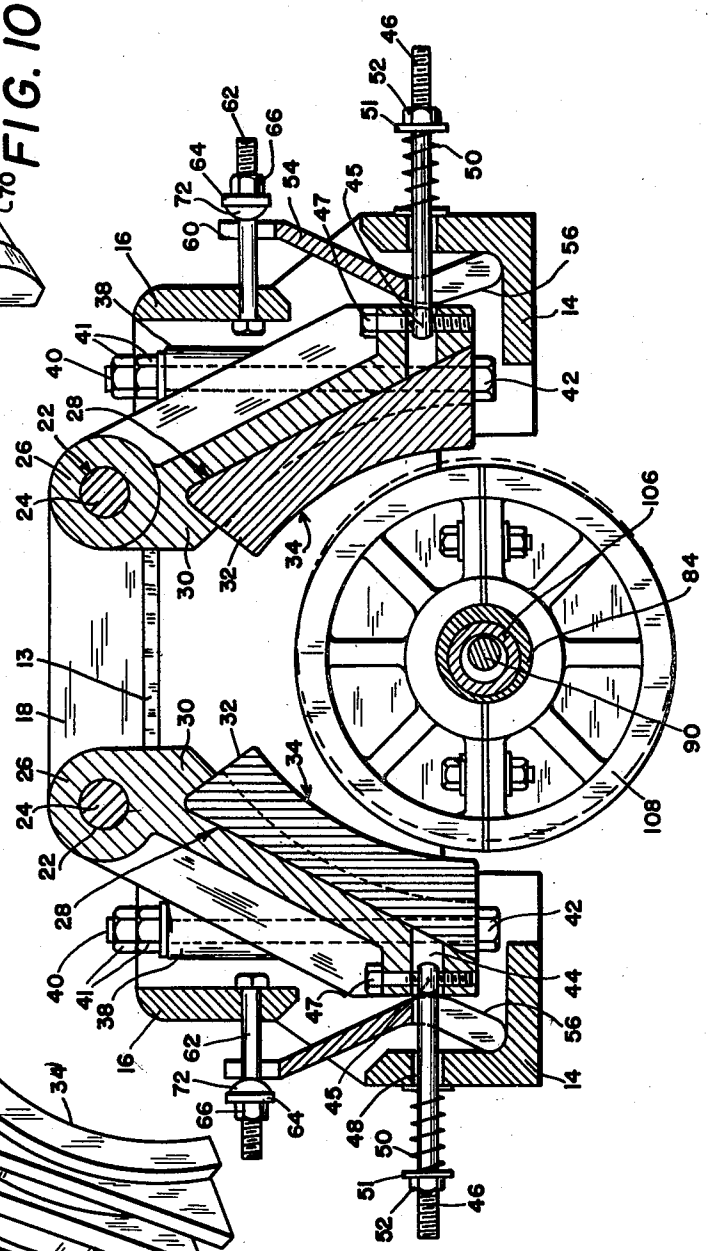
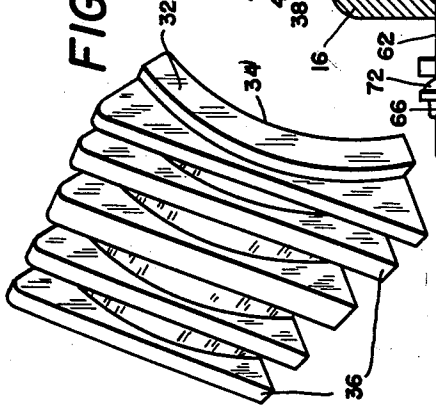


FIG. 9



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FIG. 3

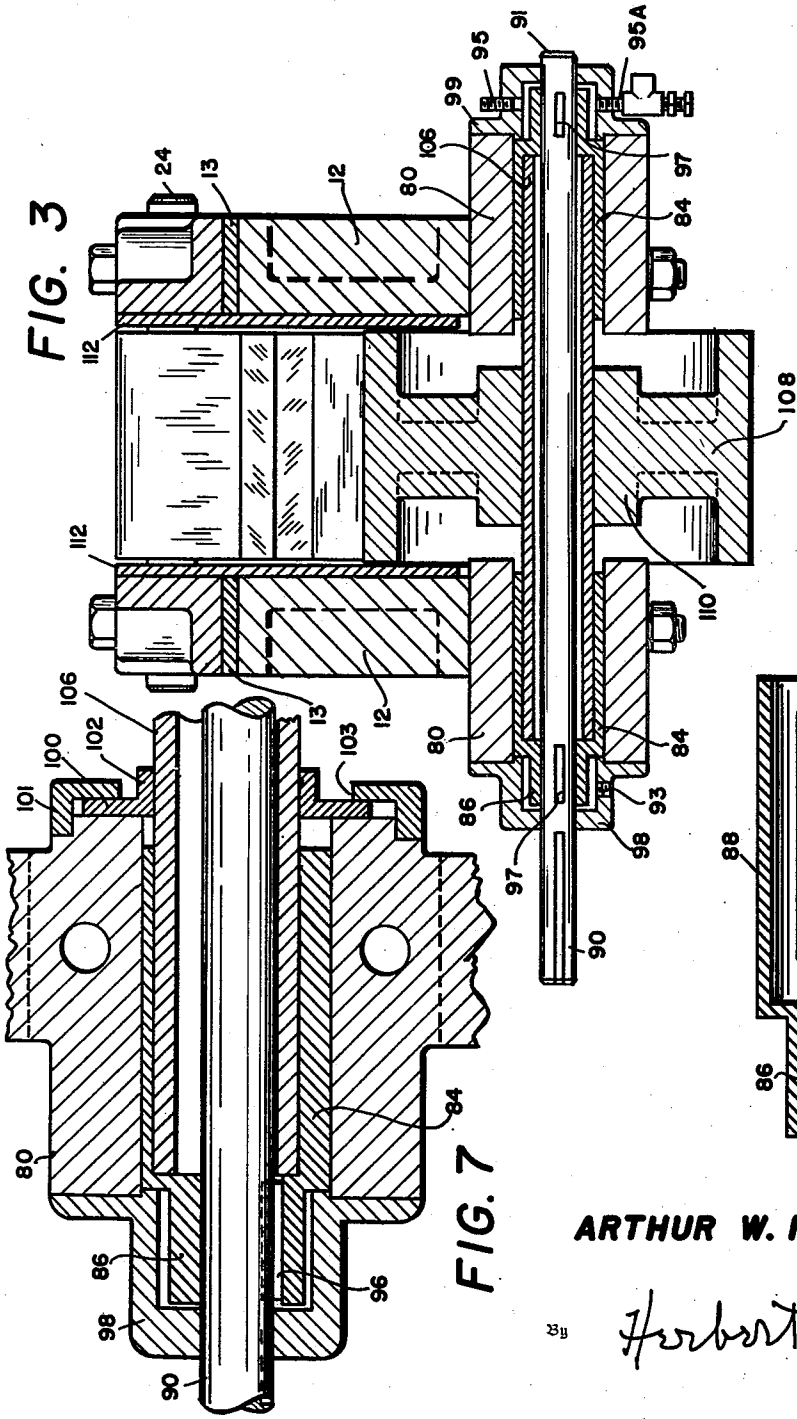
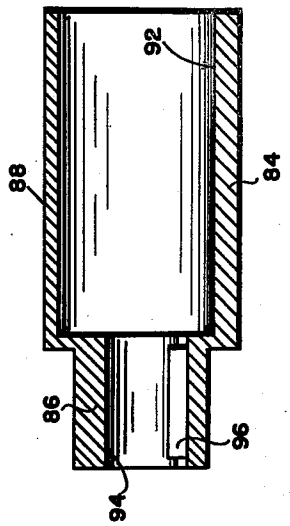


FIG. 7

FIG. 8



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2,303,923

CRUSHER

Arthur W. Fahrenwald, Moscow, Idaho

Application June 18, 1940, Serial No. 341,173

5 Claims. (Cl. 83—53)

My present invention relates to improvements in a crusher of the type primarily used for crushing rock, ore, and the like to reduced and uniform sizes.

Certain types of crushing mechanisms used in the art are rather highly developed. It is well recognized, however, that the eccentrically agitated roll type crusher has met an only relatively slight usage and yet the principles of such a device, if properly coordinated and arranged in order so that the maximum efficiency and operability is to be obtained, produce a very fine machine.

Heretofore roll crushers, such few as have been developed, invariably have employed a roll driven from an eccentric shaft, which manner of driving causes an overbalanced load wherein the eccentric shaft weight, together with the weight of the roll, is caused to be rotated, thus producing excessive vibration and undue wear.

Heretofore roll crushers have also employed fixed or stationary jaws which are primarily disposed somewhat below a horizontal plane passing through the horizontal axis of the roll and this arrangement has produced excessive wear, unnecessarily early re-placements and renewals of the crusher roll and the fixed jaws, and also undue wear and strain upon the roll shaft and its agitating mechanism.

In addition to producing excessive wear, the low placement of fixed jaws with relation to the roll results in reduced capacity because of the impossibility of choke feeding such a crusher, and also results in the production of a greatly excessive amount of "fines" rather than a quantity of crushed material having a fairly uniform size. High power consumption is another direct result of the arrangement of the jaws below the roll.

Heretofore the roll crushers have invariably also included fixed jaws which were absolutely immovable to the end that when an unbreakable object, such as a piece of steel or an extremely hard piece of rock or ore, was introduced between the fixed jaw and the roll jaw, there was no give or release for the fixed jaw and the continued application of power caused the machine to injure itself, as by straining the bearings or springing the drive shafts, or actually breaking the fixed jaws. With the foregoing in mind, it is believed that the following objects of my invention will be more readily understandable.

It has been an object of this invention to provide a crusher in which the fixed jaws or shoes are positioned in the crusher frame wholly above the horizontal axis of the crusher roll so that the material to be crushed can be fed at what is referred to as a "choke feed," and the material will rest upon the roll and will be drawn into the crushing jaws as rapidly as the jaws are freed of the material being crushed.

Another important object of my invention has been to provide a roll crusher in which the jaws are swingingly positioned in the crusher frame and are capable of being tensioned or supported in adjusted position so that when an unbreakable or uncrushable object is encountered, the fixed jaw will be released and the possibility of self-injury in the crusher will be eliminated.

A further object of this present invention has been the provision of means for readily altering the positioning of the fixed jaws with relation to the roll jaws or roll crusher so that the crushing scope of the machine can be varied to produce a crushed material of varied size.

Another object of the invention is the provision of releasing means for the fixed jaws operable when an uncrushable or unbreakable object is encountered, which means can be readily readjusted as soon as the jaws are cleared of such unbreakable objects and the machine then is continued in operation.

Still another object of this invention has been to provide a crusher having fixed jaws which may be readily disassembled from the crusher housing for repair or replacement, as the case may be.

Still a further object resides in the provision of means for eccentrically agitating the roll of a roll crusher which is free-floating, and obviates the disadvantages of the eccentric shaft method of agitating the roll crusher.

Still another object of this invention has been the provision of operating means in roll crushers which consist primarily in a pair of bearinged eccentric bushings, each of which bushings are driven simultaneously by the same drive shaft, and supporting at the same time at each end a roll shaft, which is capable of floating free in said bushings.

Other objects and advantages of the invention will be apparent during the course of the following description. In the drawings, wherein for the purpose of illustration I have disclosed a preferred form of my invention, and in which I have used like numerals to designate like parts throughout the same.

Figure 1 is a view in elevation of a roll crusher embodying the principles of my invention,

Figure 2 is a vertical medial sectional view of a roll crusher disclosing the interior arrangement

of parts relating to the eccentric roll operating means and the fixed crushing jaws,

Figure 3 is a vertical sectional view taken at right angles to the sectional plane of Figure 2 and taken on lines 3—3 of Figure 1,

Figure 4 is a perspective view of a jaw bumper utilized in connection with my crusher mechanism,

Figure 5 is a detailed plan view partially in section illustrating the manner in which the jaw bumper and a breaker strip are utilized in connection with the crusher,

Figure 6 is a verfical sectional view through a portion of the bearinged support mechanism for the eccentric bushings,

Figure 7 is an enlarged horizontal sectional view taken on lines 7—7 of Figure 6,

Figure 8 is a sectional view through an eccentric bushing taken on the same plane as Figure 7.

Figure 9 is a perspective view of a fixed jaw or crusher shoe, and

Figure 10 is a perspective view of a breaker bridge employed in connection with the jaw bumper of Figure 4.

In the drawings, the reference numerals 12—12 designate side plates of the crusher and between the lower end corners of the side plates 12 are angular structural members 14 which are spaced apart in the bottom, leaving an open crushing and discharge zone. Between the upper, outer corners of the side members 12 are structural members 16.

Upon the upper edges or faces of the members 12 are secured a pair of pivot blocks 18—18 by means of the bolts 20, which pass through bosses 21 in the blocks. In each block I form trunnions 22 for cross shafts 24—24, which are normally mounted for free turning. Between each pivot block and the upper portion of the side plates 12, 12 may be fitted spacer plates 13, 13.

Depending from each of the cross shafts 24 is a fixed jaw holder 26 which includes a jaw supporting face 28 and a shoulder 30 which serves as a stop in the positioning of the jaw 32 in the holder 26. The jaws, as may best be seen in Figure 9, are curved and the crushing face 34 is actually a segment of a cylinder having a radius greater than the radius of the roll jaw.

On the back of the jaw 32 are a plurality of backing ribs 36 which have plane surfaces that rest against the face 28 of the holder 26. Suitable bosses 38 on the holder are provided and bolts 40 are passed between pairs of the backing ribs 36 and through the bosses 38 and nuts 41, as may clearly be seen in Figure 2, hold the bolt head 42 up against the lower edges of the ribs and in turn the jaw is held up tightly against the face 28 with the upper ends of the ribs being seated against the shoulder 30.

In the lower portion of the holder 26 I provide a passage 44 into which is fitted the eye 45 of jaw holder bolt 46, and a pintle 47 is passed through the eye 45 to retain the bolt in the passage 44. The bolt passes through an opening 48 in the member 14 and a spring 50 encircles the bolt and at one end is seated against the frame member 15 and at the other end against a washer 51, which is retained by means of a nut 52.

A fixed jaw setting lever 54, shown in perspective in Figure 4, includes a lower lever portion 56 having an intermediate slot 57 which permits straddling of the bolt 46. The curved knee 58 rests against the lower side face of the holder 26. The toes 59 of the lever portions are seated in the angle of the structural members 14, and this arrangement serves as a fulcrum for the bumper member. On the upper end of the member 54 is a bridging fork 60 and a jaw setting bolt 62, anchored at one end and the member 16, passes between the fingers of the fork. A breaker bridge 64 is seated over the jaw setting bolt and rests against the fingers of the fork 60 and is retained in place by means of the nut 66. The breaker bridge is clearly shown in Figure 10 and may comprise a central web portion 68 having a hole 70 therethrough for the engagement of the bolt 62 and on one face near the ends are provided segmental rockers 72 which rest on the fork fingers 60.

A bearing block 80 is supported on the lower edge or face of each crusher side plate 12 and the bolts 20 pass therethrough, and by means of the nuts threaded thereon assist in retaining the block tightly up against the frame member 12, as also do bolts 82, 82. An eccentric bushing 84 having an end drive-collar 86 is bearinged in the block 80. The outer surface 88 of the bushing is concentric with the main axis of the drive shaft 90. The inner face 92 of the bushing is eccentric to the face 88. The bore 94 in the collar 86 is concentric with the face 88 and is adapted to engage and, by means of the key 96, be secured on the drive shaft 90, which has a corresponding key way 97.

The eccentric bushing is sealed in the bearing block 80 by means of dust caps 98 and 99 at the outer ends of said bushings and each of the inner ends of the bushings are sealed by means of an oil retainer ring 100 and a retainer cap 101. A hollow roll shaft 106 is set in the inner eccentric bore 92 of each of the eccentric bushings and encloses the drive shaft 90. The oil retainer ring 100 has a flange 102 which fits snugly around the outer surface of the shaft 106 and the retainer cap 101 has a fairly large central opening 103 which permits the flange of the ring 100 to float with the eccentric motion of the shaft 106 and at all times maintain a dust-proof seal so that the dust and fine rock of the grinding operation cannot penetrate and produce abnormal bearing wear.

Between the inner faces members 12 on the hollow roll shaft 106 is supported the roll crusher element 108 which has a central hub 110 adapted to be fitted around and be supported by the shaft 106. The outer face of the roll is herein shown to be smooth or plain, but it is to be understood that any suitable configuration such as lateral, circular, or spiral ribbing may be used, or whatever form is necessary to produce satisfactory crushing of rock and the like between the roll and the fixed jaws.

In Figure 3 the numerals 112 designate a pair of cheek plates which are supported on the cross shafts 24, 24 and depend loosely between the edges of the roll 108 and the inner faces of the frame members 12. These cheek plates are provided to insure the maximum of wear and are so designed that they may be readily replaced if they wear to any appreciable extent.

While I have not indicated an oil pump, quite often it is convenient and advisable to have a pump closely associated with such a mechanism as is shown in the drawings, and for that reason, the outer end 91 of the shaft 90 is shown protruding from the bearing cap 99. A pump may be secured to the shaft end 91 and by suitable conduit means the oil be conveyed to the eccentric bushings and under pressure be forced throughout the surfaces needing lubricant. The

bearing cap 98 has an opening 93 adapted to receive a pipe connection such as 95 and 95a, shown in the cap 99.

Method of operation

With the parts of my machine arranged as is clearly disclosed in Figure 2, the crusher is ready for operation. It will, of course, be understood that a pulley or other drive means (not shown) would be attached to the drive shaft 90, probably in the left end of that shaft, as viewed in Figure 3, whereby rotary motion would be supplied by the shaft and through the shaft to the eccentric bushings 84, thence through the hollow or tubular shaft 106 to the roll 108. The rotary motion of the drive shaft will cause an eccentric gyration of the roll so that its axis travels in a cylindrical path. It must be borne in mind, of course, that the eccentrics 84 are keyed to the shaft 90 in exactly the same relation so that each end of the shaft to which the roll is fixed is gyrated in exactly the same manner at exactly the same moment.

The fixed jaws, when the machine is ready for operation, will be positioned as shown in Figure 2. The curvature of the jaw and the adjacent curvature of the roll form a curved divergent crushing passage on each side of the roll, which passages are exactly the same in form. It is again pointed out that the lower edge of the curved fixed jaws 32 terminates above a horizontal plane passing through the roll axis and that, therefore, the fixed jaws are wholly above that axis.

When the material to be crushed is introduced between the upper ends of the fixed jaw holders 26 and the inner sides of the pivot blocks 18, which assembly constitutes a feed throat, the material follows by gravity upon the roll 108 and its weight is entirely supported upon the roll rather than upon the shoes, as would be the case if the shoe extended below the horizontal axis of the roll. This is an important difference in my crusher over such of the prior art that has come to my attention. I thus obviate resistance near the toe of the fixed shoe to a free flow of the material through the crushing passage, and I also avoid excessive wear of the fixed jaw at that point.

With the material to be crushed resting upon the roll, the roll is caused to gyrate in its eccentric path and portions of the material are interposed by gravity and agitation between the fixed jaw and the surface of the roll. Upon each stroke of the roll, these portions are reduced in size, and as they reduce in size are caused to pass through a lower point in the curved converging crushing passage. The rate of flow of the material through the crushing passage varies from the mouth to the discharge end. The flow is slowest at the mouth where the machine is acting upon the large pieces because there a tangent to the roll surface approaches the horizontal. Conversely the flow of the material is fastest at the discharge of said throat or passage where the tangent of the roll approaches and actually reaches a true vertical.

At or near the outlet of the curved crushing space the particles being crushed fall freely under the force of gravity. As they reduce in size they spread into a ribbon or stream of rock pieces substantially a particle thick. The thickness of a particle is determined by the spacing between the lower end of the curved fixed shoe and the periphery of the roll. Thus it will be seen the crushing rate is restricted in the coarse zones and is expedited in the finishing zones. From this, free crushing results are obtained. These results reside principally in the production of a minimum amount of "fines" in the finished product, a low horse-power per ton required for crushing, and the life of the fixed jaws by my arrangement is materially enhanced.

It will be seen from the showing of Figures 2 and 3 that the crushing force upon the roll is always distributed between and borne by two bearings, in distinction to the eccentric shaft mechanism wherein the crushing load is entirely taken by the bearing in the roll, which is subjected to excessive punishment, particularly when a severe crushing blow is struck near the edge of the roll. Through the use of my eccentric bushing mechanism I neutralize part of the unbalanced load when the roll is swung in its eccentric path. Whereas in the eccentric shaft the unbalanced part of the weight of the shaft is added to that of the roll which results in excessive and unnecessary vibrations, causing crystallization of operating parts and machinery failures.

When it is necessary to renew the roll shell, to replace the eccentric bushings, or to make other repairs in the machine the bearing block 80, the eccentric operating mechanism, and the roll may all be removed from the crusher frame by the simple operation of removing the nuts from the bolts 20, 20 and 82, 82, and dropping downwardly this whole mechanism as a unit.

The replacement of the fixed jaws is equally as facile for the reason that the bolts 40 are all that are holding the fixed jaw against the jaw holder 26 and that by removing the nuts 41 from the bolt the jaw can be dropped downwardly for ready replacement.

When an uncrushable object is inadvertently introduced into the machine, and the stroke of the roll fails to crush the object and the entire force of the stroke is conveyed to the fixed jaw with sufficient force to cause damage, the breaker bridge 64 will snap in two. This releases the forked end 60 of the lever 54. The spring 50 on the bolt 46 will then expand and draw the lower end of the pivoted fixed jaw holder away from the roll and release the uncrushable object so that it can fall out of the machine. This feature is very important for the reason that it is quite a common occurrence in crushing to encounter steel objects such as large bolts, nuts, and other parts of machines which become intermingled with crushable material and may cause serious damage. Once the uncrushable object is freed from the crushing space, the nut 52 can be backed off the bolt release, the tension of the spring 50 and the lever 54 can be returned to proper positioning, a new breaker bridge fitted over the bolt 62 and secured in place by means of the nut 66. Then by tightening nuts 66 and 52 the fixed jaw can again be set to the proper degree of grinding. Through the breaking of the breaker bridge 64, the structural features of the machine are protected against unnecessary injury.

The important bearing surfaces of the invention, as has been described before, can be adequately and simply protected by forced lubrication means of any practical type, and because the lubrication of such a machine forms no important part of this invention, the details are not outlined.

If it is desired to raise the lower terminal of the jaw 32, the bolts 20 can be loosened and the pivot blocks 18 raised and additional spacers sim-

ilar to the spacer plates 13, 13 inserted. Or if it be desired to lower the terminal ends of the jaws, spacers 13, 13 may be removed in a similar manner. In this way is the seat of the crushing jaws varied for different types of crushing.

It is to be understood that the form of my invention, herewith shown and described, is to be taken as a preferred example of the same, and that various changes in the shape, size and arrangement of parts may be resorted to, without departing from the spirit of my invention, or the scope of the subjoined claims.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. A crusher comprising a housing frame, a gyratory roll journaled in said frame, a jaw swingingly supported adjacent said gyratory roll, a jaw setting lever fulcrumed in said housing frame and comprising a lower lever portion having a passage, an intermediate curved knee, and an upper bridging port, a jaw holder bolt anchored to the lower end of the fixed jaw and passing through the passage in the lower lever portion of the jaw setting lever, and secured under spring tension in said housing frame, a setting bolt supported from said housing frame and passing through the said bridging port, and a bridge on said setting bolt, and spanning said bridging port, said bridge being fracturable under the influence of excessive pressures to release said hinged jaw.

2. In a crusher of the class wherein a gyratory roll is operated in close proximity to a jaw hinged at its upper end in a supporting frame and having a spring drawn holder bolt anchored to its lower end and mounted in said frame, the combination of a lever having an end seated on said frame and an element abutting said hinged jaw, the other end of said lever being bifurcated, a breaker bridge across said bifurcated end, and an anchored jaw setting bolt holding the breaker bridge and the lever in an adjusted position to maintain the hinged jaw against the urgence of the spring drawn holder bolt.

3. In a crusher of the class wherein a gyratory roll is operated in close proximity to a jaw hinged at its upper end in a supporting frame and having a spring drawn holder bolt anchored to its lower end and mounted in said frame, the combination of a bent lever having the lower leg end seated on said frame and adapted to straddle the holder bolt, said bent portion abutting said hinged jaw adjacent the point of anchor of said bolt thereto, the other end of said lever extending upwardly and having a bifurcated end, a breaker bridge spanning said bifurcation, and an anchored jaw setting bolt holding the breaker bridge and the bifurcated lever in an adjusted position so that the abutment against the hinged jaw resists the urgence of the spring pressed holder bolt.

4. In a crusher of the class wherein a gyratory roll is operated in close proximity to a jaw hinged at its upper end in a supporting frame and having a spring drawn holder bolt anchored to its lower end and mounted in said frame, the combination of a lever having an end seated on said frame and an intermediate portion abutting with said hinged jaw, an anchored jaw setting bolt adapted to cooperate with the other end of said lever to hold it in an adjusted position to maintain the hinged jaw against the urgence of the spring drawn holder bolt, and fracturable means between said bolt and the free end of said lever having a breaking strength less than the other parts of the machine and adapted to give way under unusual strain and prevent injury to the other parts.

5. A crusher comprising a housing frame, a gyratory roll having a horizontal axis of gyration and within said housing frame, a hinged jaw swingingly supported adjacent said roll and having a crushing face spaced therefrom to form a crushing area in cooperation with said roll, a lever mounted to swing about an end and having a shoulder intermediate its ends abutting said hinged jaw, means including a fracturable element retaining the outer free end of said lever in a position that maintains the shoulder against the hinged jaw and to thereby retain the latter in an adjusted position, said fracturable element having a rupture point low enough to permit a fracture when a predetermined maximum load is placed upon the elements of the crusher.

ARTHUR W. FAHRENWALD.